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(54) Processing stabiliser compositions

(57) An additive, useful as a processing stabilizer for polymers, comprises a blend of

a) one or more phosphonites or phosphites
andb) a hydrolysis stabilizer selected from compounds containing a sterically hindered amine group
and micronized zinc oxide.Also, zinc oxide or a compound containing a 2,2,6,6-tetramethyl piperidiny1 group may be used as a
hydrolysis stabilizer. For phosphorus compounds in polymeric compositions.

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Processing stabiliser composition

The invention relates to new compositions for stabilizing polymeric materials against degradation which takes place e.g. during processing at high temperatures, during the "natural" aging of polymers in the form of pelletized or non-extruded shaped material or in the form of finished polymer articles or during "artificial" aging such as oven aging tests at elevated temperatures, UV light stability tests or weatherability tests.

Phosphites and phosphonites (for example Sandostab P-EPQ) are well known processing stabilizers for a variety of polymers and have been commercially used for many years. Despite their importance for a wide scope of polymers and their high performance as stabilizers, phosphites and phosphonites have the drawback that they can hydrolyze in the presence of moisture, which adversely affects (i.e. reduces) their storage stability as well as their effectiveness in protecting polymeric materials against degradation.

Hydrolytically decomposed phosphites and phosphonites are far less effective when used as stabilizers and, hence, generally produce undesired impurities into polymers. Hydrolysis of phosphites and phosphonites can even lead to a reverse effect on their stabilizing properties so that degradation of polymers is accelerated.

It is, therefore, of paramount importance not only to safeguard the neat phosphites and phosphonites themselves against hydrolysis during storage but also to inhibit their hydrolytic decomposition in polymers.

It is an important advantage that the phosphonites, when incorporated into polymers, are also protected against the influence of moisture, humidity and water so that the properties of the polymers are not adversely affected.

The hydrolysis of phosphites and phosphonites finally leads to products with acidic properties and also to undesired free phenol. Such acids formed in the polymer can accelerate the degradation of the polymer chains and can, moreover, cause many disadvantageous side effects. Such negative effects are acute during the processing of polymers at elevated temperatures. It was found that hydrolyzed processing stabilizers can cause, for example, enhanced formation of undesired gel particles, especially in polyethylenes, or can lead to increased amounts of phosphorus containing black specks. It has also been observed that the corrosion of the processing equipment can be accelerated by the acid products of such hydrolysis reactions. Furthermore, hydrolyzed processing stabilizers were found to reduce the effectivity of sterically hindered amine light stabilizers (HALS) as well as the performance of primary phenolic antioxidants relating to the long term stabilization of polymers.

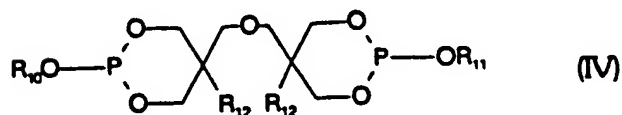
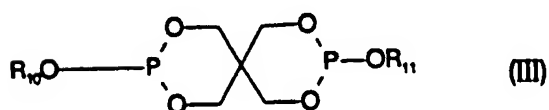
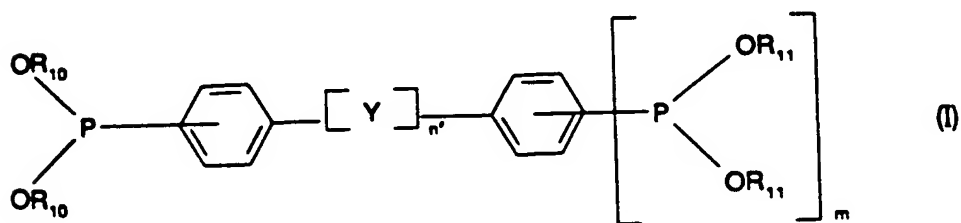
Therefore, there is a real need to improve the resistance of phosphites and phosphonites against hydrolysis. In particular, the need to protect these processing stabilizers especially in polyolefins produced with Generation II to V catalysts (supported catalysts) results directly from the requirement to maintain optimum polymer properties.

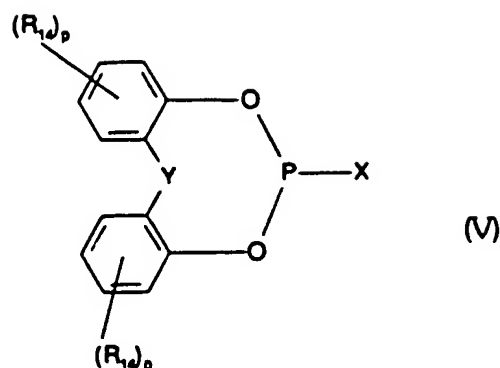
Such a series of detrimental consequences due to the hydrolysis of processing stabilizers themselves as well as processing stabilizers containing polymers can be avoided by the present invention.

Therefore, the high performance of phosphites and phosphonites as stabilizers for polymers, especially when used for maintaining melt flow and color stability, can be safeguarded by a composition according to the present invention so that their application under the normal environmental conditions, including moisture and humidity, is significantly improved. Surprisingly has been found that even phosphonites of high hydrolytic sensitivity can be protected according to the invention.

According to the invention there is provided an additive, useful as a processing stabilizer for polymers, the additive comprising a blend (preferably a homogeneous blend) of :

- a) one or more phosphonites or phosphites, preferably of formulae I to V (hereinafter defined as component a)





in which

m is 0 or 1;

n' is 0 or 1;

p is 0 to 4, preferably 1 to 3

each R_{10} and each R_{11} , independently, is a group derived from an aliphatic, or alicyclic or aromatic alcohol containing one or two OH groups; whereby the two -OH groups are not positioned to be able to form a P-containing ring; (hereinafter defined as the monovalent significances of R_{10} or R_{11} respectively);

or both groups R_{10} and/or R_{11} form a group derived from an aliphatic, alicyclic or aromatic alcohol containing two or more OH groups in such a position that they can form a cyclic group with a single phosphorus atom (hereinafter defined as the divalent significances of R_{10} or R_{11} respectively);

R_{12} is -OH, CH_2OH or C_{1-4} alkyl.

each R_{14} independently is selected from C_{1-22} alkyl or C_{7-22} aralkyl;

X is F or -O- R_{10} ;

Y is -O-, -S-, -CH(R_{15})- or - C_6H_4 -, where R_{15} is hydrogen or C_{1-8} alkyl or COOR_6 and R_6 is C_{1-8} alkyl; with

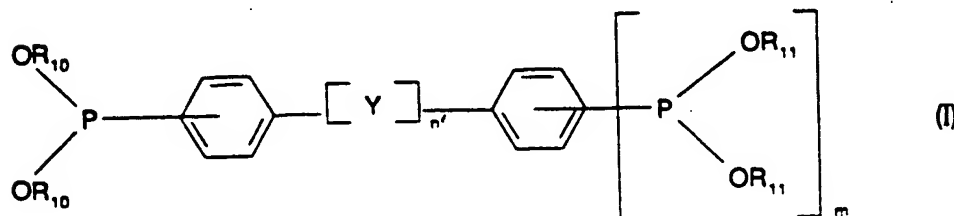
- b) a hydrolytic stabilizer selected from compounds containing a sterically hindered amine group (preferably a sterically hindered piperdiny group) and micronized zinc oxide (hereinafter defined as component b).

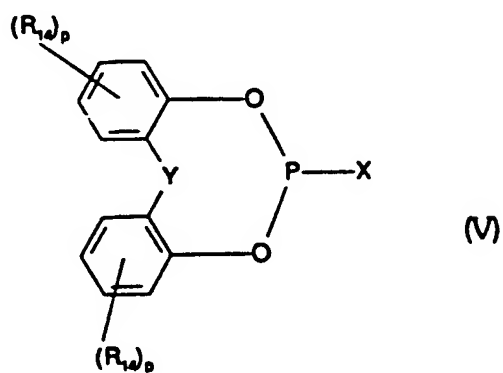
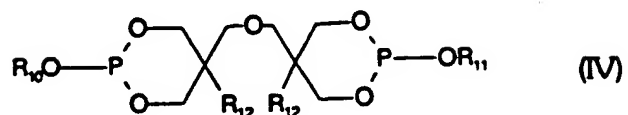
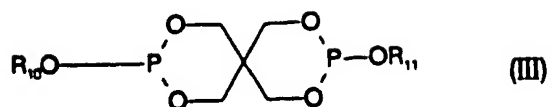
In the past the components a) and b) have been added individually to the polymeric compositions. What we have found is that by blending the compounds as a stabilising composition, prior to addition to the polymer, the disadvantages of hydrolytic instability can be avoided.

Further according to the invention there is provided a process, for stabilising a polymeric composition, comprising

i) blending

- a) one or more phosphonites or phosphites, preferably of formulae I to V (hereinafter defined as component a)





in which

m is 0 or 1;

n' is 0 or 1;

p is 0 to 4, preferably 1 to 3

each R_{10} and each R_{11} , independently, is a group derived from an aliphatic, or alicyclic or aromatic alcohol containing one or two OH groups; whereby the two -OH groups are not positioned to be able to form a P-containing ring; (hereinafter defined as the monovalent significances of R_{10} or R_{11} respectively);

or both groups R_{10} and/or R_{11} form a group derived from an aliphatic, alicyclic or aromatic alcohol containing two or more OH groups in such a position that they can form a cyclic group with a single phosphorus atom (hereinafter defined as the divalent significances of R_{10} or R_{11} respectively);

R_{12} is -OH, CH_2OH or $\text{C}_{1-4}\text{alkyl}$.

each R_{14} independently is selected from $\text{C}_{1-22}\text{alkyl}$ or $\text{C}_{7-22}\text{aralkyl}$;

X is F or $-\text{O}-R_{10}$;

Y is $-\text{O}-$, $-\text{S}-$, $-\text{CH}(\text{R}_{15})-$ or $-\text{C}_6\text{H}_4-$, where R_{15} is hydrogen or $\text{C}_{1-8}\text{alkyl}$ or COOR_6 and R_6 is $\text{C}_{1-8}\text{alkyl}$; with

- b) a hydrolytic stabilizer selected from compounds containing a sterically hindered amine group (preferably a sterically hindered piperdiny group) and micronized zinc oxide (hereinafter defined as component b);

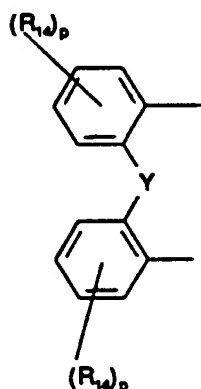
followed by

- ii) adding this blend to the polymeric material.

Preferably the amount of component b) per 100 parts of component a) is 0.05-15 parts.

Preferably in component a) the monovalent significances of R_{10} and R_{11} are independently derived from linear branched or cyclic C_{1-24} aliphatic alcohols; or phenols, preferably substituted by 1 to 5 groups selected from C_{1-12} alkyl and C_{7-22} aralkyl groups.

Preferably the divalent significances of R_{10} and R_{11} (which are derived from bisphenols) are of the formula



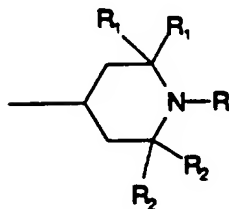
where each R_{14} independently is selected from C_{1-22} alkyl or C_{7-22} aralkyl.

Further according to the invention there is provided the use of a compound containing a 2,2,6,6-tetramethyl piperidinyl group as a hydrolysis stabilizer for phosphorus compounds for example phosphonites and/or phosphites preferably of formulae I to V in polymeric compositions.

Preferably according to the invention, there is provided an additive, useful as a processing stabilizer for polymers, the additive comprising a blend (preferably a homogeneous blend) of

- a) one or more phosphonites or phosphites, preferably of formulae I to V defined above (component a) with
- b) a hydrolytic stabilizer selected from compounds containing a sterically hindered amine group (preferably a sterically hindered piperdinyll group)

Preferably when component b) is selected from compounds containing a sterically hindered amine group (preferably a sterically hindered piperdinyll group) the sterically hindered amine group is of the formula α)



α)

in which

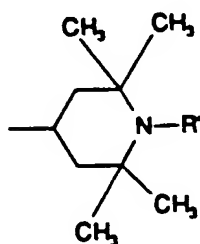
R is hydrogen; oxygen; -OH; C_{1-24} alkyl; -O- C_{1-24} alkyl; -O-CO- C_{1-24} alkyl; -O-CO-phenyl or -COR₅; where R₅ is -C(R₃)=CH₂, C_{1-12} alkyl, phenyl, CO- C_{1-24} alkyl, -CO-phenyl, -NR₇R₈, -CH₂-C₆H₅, -CO-OC₁₋₁₂alkyl or -COOH; R₃ is hydrogen or C_{1-4} alkyl; R₇ is hydrogen, C_{1-12} alkyl, C_{5-6} cycloalkyl, phenyl, phenyl- C_{1-4} alkyl or C_{1-12} alkylphenyl and R₈ is C_{1-12} alkyl or hydrogen,

each R_1 , independently, is $-\text{CH}_3$ or $-\text{CH}_2(\text{C}_{1-4}\text{alkyl})$ or both groups R_1 form a group $-(\text{CH}_2)_5-$; and

each R_2 , independently, is $-\text{CH}_3$ or $-\text{CH}_2(\text{C}_{1-4}\text{alkyl})$ or both groups R_2 form a group $-(\text{CH}_2)_5-$.

Such a group of formula α) is known as a Hindered Amine Light Stabilizer (HALS).

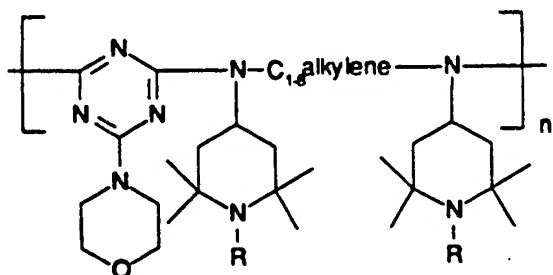
More preferably when component b) is a sterically hindered amine, it is selected from a compound containing a group of formula α'



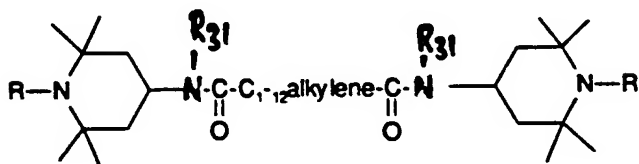
where R' is hydrogen, O, OH, $\text{C}_{1-12}\text{alkyl}$, $\text{C}_{1-12}\text{alkoxy}$ or $-\text{CO}-\text{C}_{1-8}\text{alkyl}$.

Preferred compounds containing a sterically hindered amine group of component b are selected from HALS 1-HALS 17 below

HALS 1

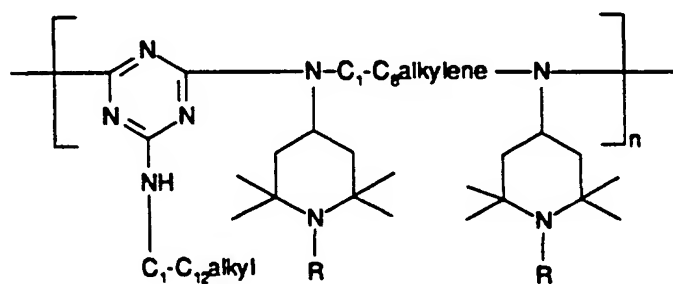


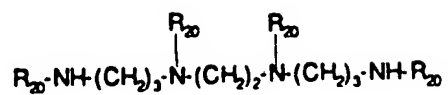
HALS 2



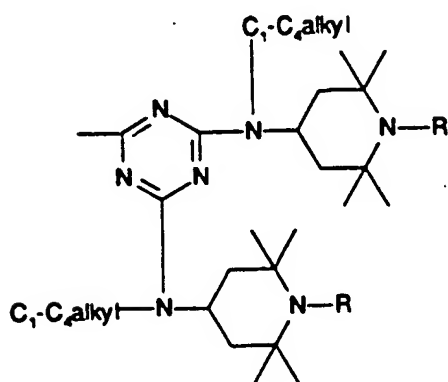
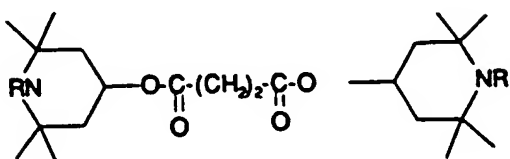
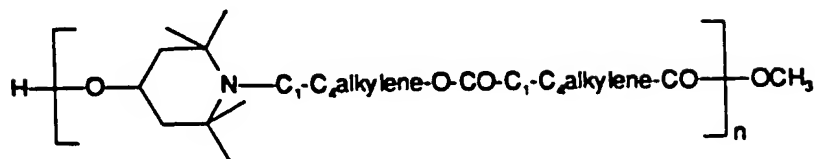
where R_{31} is hydrogen or C_{1-8} alkyl

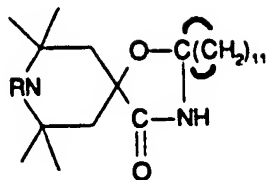
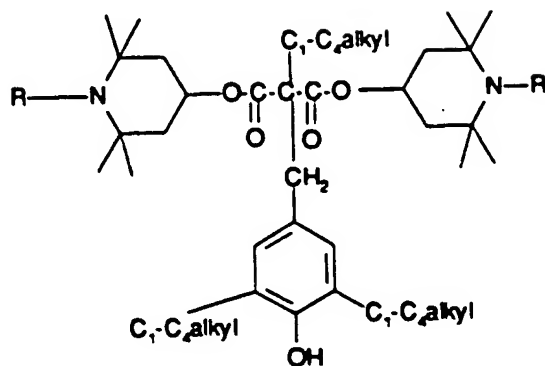
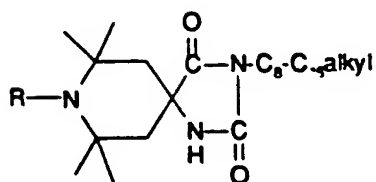
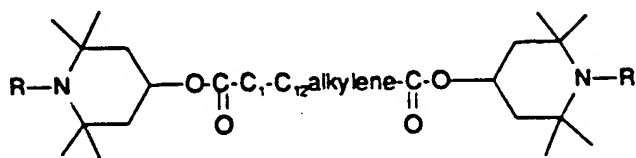
HALS 3

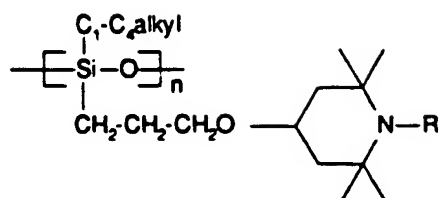
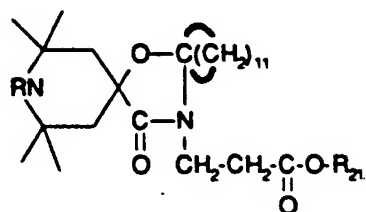


HALS 4

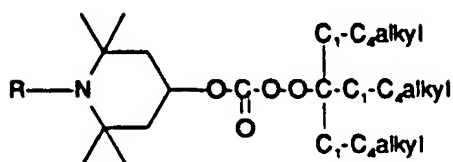
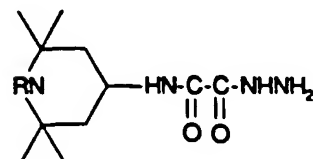
where R_{20} is

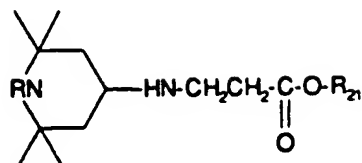
**HALS 5****HALS 6**

HALS 7**HALS 8****HALS 9****HALS 10**

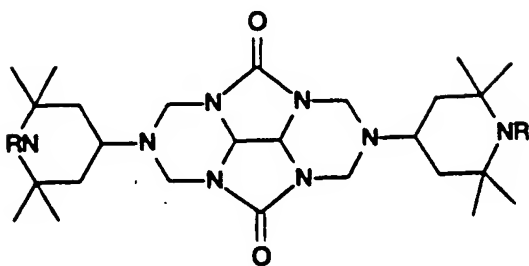
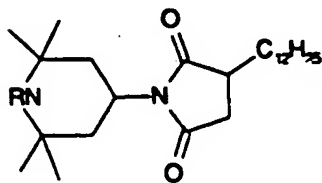
HALS 11**HALS 12**

where R_{21} is C_{12-14} alkyl (e.g. a mixture of $\text{C}_{12}\text{H}_{25}$ and $\text{C}_{14}\text{H}_{29}$);

HALS 13**HALS 14**

HALS 15

where R_{21} is as defined above

HALS 16**HALS 17**

in which in **HALS 1** to **HALS 17**

R is R' where R' is hydrogen, O, OH, C_{1-12} alkyl, C_{1-12} alkoxy or $-CO-C_{1-8}$ alkyl and

n is a number from 3 to 20.

Most preferred compounds containing a sterically hindered amine group are as follows:

Bis (2,2,6,6-tetramethyl-4-piperidyl) sebacate;

Bis(1,2,2,6,6-pentamethyl-4-piperidiny)(3,5-ditert.butyl-4-hydroxybenzyl)butylpropane dioate;

Bis (1,2,2,6,6-pentamethyl-4-piperidiny) sebacate;

8-Acetyl-3-dodecyl-7,7,9,9-tetramethyl-1,3,8-triazaspiro(4,5)decane -2,4-dione;

Butanedioic acid, bis(2,2,6,6-tetramethyl-4-piperidiny) ester;

Tetrakis (2,2,6,6-tetramethyl-4-piperidyl)-1,2,3,4-butane tetracarboxylate;

(2,2,6,6-tetramethyl-4-piperidyl)/ β , β , β' , β' -tetramethyl-3,9-(2,4,8,10-tetra-oxaspiro(5'5)undecane) diethyl-1,2,3,4-butane tetra carboxylate;

7-oxa-3,20-diazadispiro(5.1.11.2)heneicosan-20-propanoic acid, 2,2,4,4-tetra-methyl-21-oxo, dodecylester ("Hostavin" N 24);

Octadecene-(N-(2,2,6,6-tetramethylpiperidiny)-4-N-maleinimido-oxalic acid diamide co-polymer;

N-(2,2,6,6-tetramethyl-4-piperidiny)-N'-amino-oxamide;

OO-t-amyl-O-(1,2,2,6,6-pentamethyl-4-piperidiny)monoperoxicarbonate;

β -Alanine, N-(2,2,6,6-tetramethyl-4-piperidiny), dodecylester;

Ethanediamide, N-(1-acetyl-2,2,6,6-tetramethylpiperidiny)-N'-dodecyl;

3-dodecyl-1-(2,2,6,6-tetramethyl-4-piperidiny)-pyrrolidin-2,5-dione;

3-dodecyl-1-(1,2,2,6,6-pentamethyl-4-piperidiny)-pyrrolidin-2,5-dione;

3-dodecyl-1-(1-acetyl, 2,2,6,6-tetramethyl-4-piperidiny)-pyrrolidin-2,5-dione; ("Sanduvor" 3058)

4-benzoyloxy-2,2,6,6-tetramethylpiperidine;

1-[2-(3,5-di-tert.butyl-4-hydroxyphenylpropionyloxy)ethyl]-4-(3,5-ditert.-butyl-4-hydroxyphenyl-propionyloxy)-2,2,6,6-tetramethyl piperidine;

2-methyl-2-(2'',2'',6'',6''-tetramethyl-4''-piperidinylamino)-N-(2',2',6',6'-tetra-methyl-4'-piperidiny) propionylamide;

1,2-bis(3,3,5,5-tetramethyl-2-oxo-piperazinyl)ethane-1-isopropyl-3,3,5,5-tetramethyl-2-piperazinone

Tetrakis (2,2,6,6-tetramethyl-4-piperidyl) 1,2,3,4-butane tetracarboxylate;

4-oleoyloxy-2,2,6,6-tetramethylpiperidine;

Poly-[(6-morpholino-s-triazin-2,4-diyl)((2,2,6,6-tetramethyl-4-piperidiny)imino)-hexamethylene-((2,2,6,6-tetramethyl-4-piperidiny)imino)];

Poly-[6-[1,1,3,3-tetramethyl-butyl)imino]-s-triazin-2,4-diyl][2-(2,2,6,6-tetramethyl-4-piperidiny)imino]hexamethylene-[4-(2,2,6,6-tetramethyl-4-piperidiny)imino)];

1,3,5-triazine-2,4,6-triamine-N,N'-(ethanediyl-bis[[[4,6-bis(butyl(1,2,2,6,6-pentamethyl-4-piperidiny)amine)-1,3,5-triazin-2-yl]imino]propane-diyl]]bis[N,N'-dibutyl-N,N'-bis(1,2,2,6,6-pentamethyl-4-piperidiny)]);

Butanedioic acid, polymer with 4-hydroxy-2,2,6,6-tetramethyl-1-piperidine-ethanol;

2,2,4,4-tetramethyl-7-oxa-3,20-diaza-dispiro[5.1.11.2]heneicosan-21-one;

Bis(1-octyloxy-2,2,6,6-tetramethyl-4-piperidiny)sebacate;

Poly(methylpropyl-3-oxy-[2,2,6,6-tetramethyl-4-piperidiny]-siloxane);

1,3,5,7,9,11-hexaaza-4,10-dione-tricyclo[12.1.1.0^{13,14}]-tetradecane-1,7-bis(2,2,6,6-tetramethyl-4-piperidiny).

Preferably the amount of component b (when a compound containing a sterically hindered amine group) present is 3-10% more preferably 3-5%.

Alternatively preferred is an additive, useful as a processing stabilizer for polymers, the additive comprising a blend (preferably a homogeneous blend) of

- a) one or more phosphonites or phosphites, preferably of formula I to V defined above (component a) with
- b) micronized zinc oxide (component b),

Preferably what is meant by micronized zinc oxide is that the particle size of zinc oxide is below 1 μ m, preferably 0.05-1 μ m.

Preferably, when component b) is zinc oxide, the amount of zinc oxide present is 5-10%, more preferably 6-8%, most preferably 7% based on the weight of component a).

Further according to the invention there is provided the use of zinc oxide (preferably micronized) as a hydrolysis stabilizer for phosphorus compounds, such as phosphonites and/or phosphites, preferably of formula I to V in polymeric compositions.

Still further according to the invention, there is provided a polymeric composition comprising a polymeric material and an additive according to the invention.

Preferably the amount of additive present is 0.01-5%, more preferably 0.1-2% based on the amount of polymeric material to be stabilized.

Polymeric materials that can be stabilized by a stabilizing composition according to the invention include homopolymers, copolymers and polymer blends of:

Cellulose acetate; Cellulose acetobutyrate; Cellulose acetopropionate; Cresol-formaldehyde resins; Carboxymethylcellulose; Cellulose nitrate; Cellulose propionate; Casein plastics; Casein-formaldehyde resins; Cellulose triacetate; Ethyl cellulose; Epoxy resins; Methyl cellulose; Melamineformaldehyde resins; Polyamide; Polyamidimide; Polyacrylonitrile; Polybutene-1 and -2; Polybutylacrylate; Poly(butylene terephthalate); Polycarbonate; Poly(chloro-trifluoro-ethylene); Poly(diallylphthalate); Polyethylene; chlorinated Polyethylene; Polyetherketone; Polyetherimide; Polyethyleneoxide; Polyethersulphone; Poly(ethylene terephthalate); Polytetrafluoroethylene; Phenol-formaldehyderesins; Polyimide; Polyisobutylene; Polyisocyanurate; Polymethacrylimide; Polymethylmeth-acrylate; Poly(4-methylpentene-1); Poly(α -methylstyrene);

Polyoxy-methylene; Polyacetal; Polypropylene; Polyphenylene-ether; Polyphenylene-sulphide; Polyphenylenesulphone; Polystyrene; Polysulphone; Polyurethane; Polyvinyl acetate; Polyvinyl alcohol; Polyvinylbutyral; chlorinated Polyvinyl chloride; Polyvinylidene chloride; Polyvinylidene fluoride; Polyvinylfluoride; Polyvinylformaldehyde; Polyvinylcarbazole; Polyvinylpyrrolidone; Silicon polymers; saturated polyester; urea-formaldehyde resins; unsaturated polyester; polyacrylates; polymethacrylates; polyacrylamides; maleinate resins; phenolic resins; aniline resins; furane resins; carbamide resins; epoxide resins and silicon resins.

Examples of suitable copolymers include:

Acrylonitrile/butadiene/acrylate; Acrylonitrile/butadiene/styrene; Acrylonitrile/methyl-methacrylate; Acrylonitrile/styrene/acrylic ester; Acrylonitrile/ethylenepropylene-diene/styrene; Acrylonitrile/chlorinated polyethylene/styrene; Ethylene/ethylacrylate; Ethylene methacrylic acid ester; Ethylene/propylene; Ethylene/propylene-diene; Ethylene/vinyl-acetate; Ethylene/vinyl alcohol; Ethylene/tetrafluoroethylene; Tetrafluoroethylene/hexafluoro-propylene; Methacrylate/butadiene/styrene; Melamine/phenolformaldehyde; Polyester blockamide; Perfluoroalkoxyalkane; Styrene/acrylonitrile; Styrene/butadiene; Styrene/maleic acid anhydride; Styrene/ α -methylstyrene; Vinylchloride/ethylene; Vinylchloride/ethylene/methacrylate; Vinylchloride/ethylene/vinyl acetate; Vinylchloride/methyl-methacrylate; Vinylchloride/octylacetate; Vinylchloride/vinylacetate; and Vinylchloride/vinylidene chloride.

Preferred polymeric materials that can be stabilized are polypropylene, polyethylene (e.g. high density polyethylene, low density polyethylene, linear low density polyethylene or medium density polyethylene), polybutylene, poly-4-methylpentene and copolymers thereof as well as polycarbonate, polystyrene and polyurethane.

Preferred polyurethanes are those prepared from isocyanate resins and polyols. Preferred isocyanates are those commercially available as Desmodur, Elastan, Lupranat, Tedimon, Scuranat, Suprasec, Systanat, Hylene, Isonate (-Papi), Multrathane, Nacconate and Sumidur.

Preferred polyols are those commercially available as Desmophen, Lupranol, Lupraphen, Glendion, Napiol, Scuranol, Caradol, Daltolac, Daltorez, Diorez, Estolan, Propylan, Armol, Bermodol, Isonol, Metpol, Multron, Multranol, Niaux Polyol, Pluracol, Quadrol, Thanol, Voranol and Sumiphen.

Such polyurethanes are as describes in Saechtling: Kunststoff Taschenbuch 23 Ausgabe- published by Carl Hansen Verlag 1986 (esp. p. 339-410). The contents of this book are incorporated herein by reference.

Preferred powder coatings are described in "The Science of Powder Coatings - Chemistry, Formulation and Application" - David A. Bate published SITA - 1990, Vol. 1, the contents of which are incorporated herein by reference, especially pp. 249-277.

The powder coating compositions to which this invention can be applied are any powder coatings known in the art. The powders may be thermoplastic or thermosetting powders and include any known acrylic polyester, epoxy or urethane powder coatings commonly available. Particularly preferred powder coatings are based on acrylate and polyisocyanate resins.

Preferred powder coating are formulations based on epoxy resins for example DER 663 UE, HULS B68, Resiflow PU5, Ceriduol, ACA8, Durcal 10 and Black Regal. Hydroxypolyester resins can be used in polyurethane powder coatings.

Powder lacquers are also described in USP 5,036,144, EP 299 420, USP 4 937 288 and JP 91-044588, the contents of which are incorporated herein by reference.

Powder coating compositions are more preferably those based on acrylic polymers or isocyanates.

Further additives that can be added to a stabilizing or a polymeric composition according to the invention include antioxidants, such as sterically hindered phenols, secondary aromatic amines or thioethers, such as described in "Kunststoff-Additive" - Gächter/Müller, Ed. 3, 1990 p.42-50, the contents of which are incorporated herein by reference; acid scavengers such as sodium-, magnesium- or calcium- stearates or lactates, hydrotalcite or alkoxylated amines; U.V. stabilizers such as sterically hindered amines (for example N-unsubstituted, N-alkyl or N-acyl substituted 2,2,6,6-tetra-methylpiperidine compounds) [also known as hindered amine light stabilizers -HALS] and U.V. absorbers (e.g. 2-(2'-hydroxyphenyl)-benztriazoles, 2-hydroxy-benzophenones, 1,3-bis-(2'-hydroxybenzoyl) benzene salicylates, cinnamates and oxalic acid diamides;), U.V. quenchers such as benzoates and substituted benzoates, antistatic agents, flameproofing agents, lubricants, plasticisers, nucleating agents, metal deactivators, biocides, impact modifiers, fillers, pigments and fungicides.

Stabilizing compositions according to the invention may be added to the polymeric material before, during or after the polymerization step and may be added in solid or molten form, in solution preferably as a liquid concentrate containing from 10 to 80 % by weight of the composition and 90 to 20 % by weight of solvent or as a solid masterbatch composition containing 10 to 80 % (more preferably 40 to 70 %) by weight of the composition and 90 to 20 % (more preferably 60 to 30 %) by weight of a solid polymeric material which is identical with or compatible with the material to be stabilized.

The additive compositions according to the invention may be incorporated by known methods into the polymeric material to be stabilized. Of particular importance is dry-blending of the compositions according to the invention with the polymer or coating shaped polymer particles, e.g. polymer spheres, with the present compositions in the form of a liquid, a solution or a suspension/dispersion. Of particular importance is blending of the compounds with thermoplastic polymers in the melt, for example in a melt blender or during the formation of shaped articles, including films, tubes, fibres and foams by extrusion, injection moulding, blow moulding, spinning or wire coating. The additive compositions according to the invention are particularly useful for polypropylene and polyethylene articles of every type as well as polycarbonate, polystyrene and polyurethane.

The new stabilizer compositions are especially suitable for use in polyolefins and especially α -polyolefins prepared using processing catalysts known as Generation II to Generation V catalysts and which have not been subjected to a catalyst removal step. By the term "catalyst removal step" used herein is meant a step for the purpose of positively removing the catalyst residues contained in the polymerized polyolefins or treating the polyolefins with the compound which can react with the catalyst residue and inactivate or solubilize the residue, such as alcohols or water, and then removing the inactivated or solubilized catalyst residue by physical means such as filtration, washing and centrifuging. Thus, in the case of suspension polymerization, the step of separating the resulting polymer from a dispersion medium, such as a solvent or a liquefied monomer, does not fall under the above-mentioned definition of the catalyst residue removal step, although the catalyst dissolved in the dispersion medium may be removed by a separation step.

The step of adding a small amount of catalyst poisons such as ethers, alcohols, ketones, esters and water to the resulting polymer, to inactivate the catalyst remaining after the completion of polymerization, or the step of treating the resulting polymer suspension with gas such as steam or nitrogen to remove the dispersion medium also does not fall under the above-mentioned definition of the "catalyst residue-removal" step.

What we mean by Generation I catalysts are titanium halide catalysts and an organo aluminium compound or an organo aluminium halide.

What we mean by Generation II catalysts are Generation I catalysts supported on an organo magnesium compound or based on an organo chromium compound supported on SiO_2 .

What we mean by a Generation III catalyst is a Ziegler type complex catalyst supported on a halogen containing magnesium compound.

What we mean by a Generation IV catalyst is a Generation III catalyst with a silane donor.

What we mean by Generation V catalysts is a bis-indenyl organo titanium compound supported on alumoxane or bis cyclopentadienyl titanium halides activated by aluminium alkyl compound.

Further generations of highly specific catalysts, especially useful for manufacturing highly stereoregular poly- α -olefins, which are presently under development, belong in the sense of the present invention also to the aforementioned generations of supported catalyst systems. Examples for the microstructure of such highly stereoregular polyolefins are given by syndiotactic polypropylene, isotactic stereoblock polymers, isotactic polypropylene containing steric defects randomly distributed along the polymer chain (so called anisotactic polypropylene) or stereoirregular stereoblock polymers. Due to the rapid progress in the development of newer generation catalyst systems the commercial significance of these polymers with novel, highly interesting properties increases more and more. However, residues of such further catalyst generations, as long as they contain metals of the 3d, 4d and 5d series of the periodic system supported analogously to the earlier catalyst generations, can also cause disadvantageous properties in the polymer, as long as such residues are still present in the polymer even if in a deactivated form.

Due to this, it can therefore be expected that the new compositions according to the invention are also suitable for overcoming such disadvantageous properties of the polymer. This means that any disadvantageous interaction between processing stabilizers and the aforementioned residues of catalysts of further generations, particularly the hydrolysis of phosphites and phosphonites, is most effectively inhibited.

These generations of catalysts are described in the Twelfth Annual International Conference on Advances in the Stabilization and Controlled Degradation of Polymers held in Luzern, Switzerland, 21-23 May 1990 in an article on pages 181 to 196 inclusive by Rolf Mülhaupt entitled "New Trends in Polyolefin Catalysts and Influence on Polymer Stability". The contents of this article is incorporated herein by reference and especially Table I on page 184 describing the Generation of Catalysts:

TABLE I Polyolefin Catalyst Evolution

Generation	Example	Cat.Act. (g/PP/gTi h atm)	% Act.Ti	Stereoreg. (% insol in heptane)	Process Technology
I.	TiCl ₄ /AlR ₃	40	0.01	45%	removal of cat.residues and atactic PP
	TiCl ₃ /AlEt ₂ Cl	30	0.1	92%	removal of catalyst residues
II	Mg(OEt ₂)/TiCl ₄ /AlR ₃	40000	HDPE	50%	no removal of cat.residues (mainly HDPE/LLDPE)
	SiO ₂ /Cp ₂ Cr	40000			
III	Mod.TiCl ₃ cat.	5000	1	95%	no purification
	MgCl ₂ /TiCl ₄ /AlR ₃ -ester donor	20000	10	92%	
IV	MgCl ₂ /TiCl ₄ /AlR ₃ -silane donor	40000	18	99%	no purification no extrusion
V	Bis-indenyl-TiR ₂ on (AlCH ₃ O) _x	40000	100	99%	novel PPs, narrow MWD

in which R, in Table 1, is an organo group; HDPE is high density polyethylene, LLDPE is linear low density polyethylene, Cp is cyclopentadienyl, Et is ethyl, PP is polypropylene, MWD is molecular weight distribution and x is an integer above 2 (preferably 2-100).

Further, in this specification, where a range is given, the figures defining the range are included therein. Any group capable of being linear or branched is linear or branched unless indicated to the contrary.

For the avoidance of doubt, in this specification t-butyl means tertiary butyl, (-C(CH₃)₃).

The invention will now be illustrated by the following Examples.

Example 1

This example shows that the hydrolytic stability of compositions according to the invention is significantly improved by the addition of sterically hindered piperidine (i.e. HALS) containing compounds.

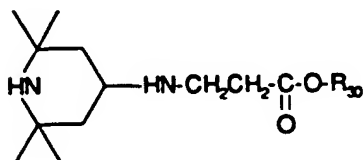
Composition A is based on samples of Stabilizer I which are products of technical quality mainly composed of tetrakis-(2,4-di-tert-butyl-phenyl)-biphenylene-diphosphonite (commercially available as SANDOSTAB P-EPQ from SANDOZ). The samples are prepared by melt blending 9g of Sandostab P-EPQ and 1g of the component b) as given below in Table 2 at 150°C in a nitrogen atmosphere. The composition is stirred for 10 minutes for homogenization and then cooled in an ice bath. The resulting glass-like product is then ground into a powder. The hydrolysis test was made under accelerating, severe conditions at 60° and 80% relative humidity. The various samples were exposed to these conditions and analyzed from time to time. Standard HPLC analysis of both, formed 2,4-di-tert-butylphenol, which is a measure of residual Stabilizer I as 82% DTBP would mean that all the SANDOSTAB P-EPQ has been decomposed.

Table 2: Hydrolytic stability of Stabilizer I in Compositions A

Sample Composition A	Content of DTBP after exposure at 60°C, 80% r.h.		
	after 1 day	after 2 days	after 3 days
a) without HALS compound	34%	52%	61%
b) plus 1% Sanduvor 3052	8%	10%	40%
c) plus 1% Tinuvin 622	18%	33%	55%
d) plus 1% Chimassorb 944	15%	41%	57%

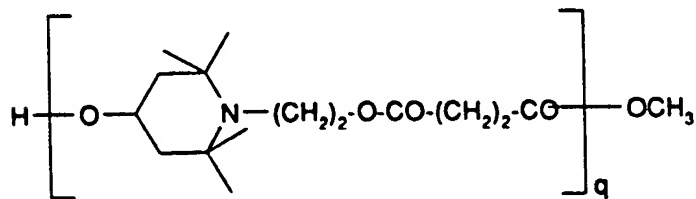
r.h = relative humidity;

Sanduvor 3052 is a compound of the formula



where R_{30} is C_{12-14} alkyl (e.g. a mixture of $C_{12}H_{25}$ and $C_{14}H_{29}$);

Tinuvin 622 is a compound of the formula



where $q = 3-20$.

*N1C(C)(C)CC(C)(C)N1C(C)(C)CC(C)(C)N(CCC2C(C)C(C)C2)C3=NC=NC=C3NCC(C)C(C)C

Example 2

To a solution of 93g tetrakis-(2,4-di-tert-butyl-phenyl)-biphenylene-diphosphonite (commercially available as SANDOSTAB P-EPQ from SANDOZ LTD.) in 250 g of chlorobenzene, 7 g of micronized [i.e. particle size less than 1 μ m (on average)] zinc oxide are added and homogenized by stirring. The solvent is removed under vacuum and the resulting melt is poured out, cooled and milled. It results in 100g of an "off"-white powder (composition A).

Example 3

The solvent of a solution of 93 g. tetrakis-(2,4-di-tert-butyl-phenyl)-biphenylene-diphosphonite (commercially available as SANDOSTAB P-EPQ from SANDOZ LTD.) in 250 g of chlorobenzene, is removed in vacuum and to the resulting melt at 120-150°C, 7 g of micronized [i.e. particle size less than 1µm (on average)] zinc oxide are added and homogenized by stirring. The resulting melt is poured out, cooled and milled. It results in 100g of an "off"-white powder (composition A).

Example 4

93 g. tetrakis-(2,4-di-tert-butyl-phenyl)-biphenylene-diphosphonite (commercially available as SANDOSTAB P-EPQ from SANDOZ LTD.) and 7 g of micronized [i.e. particle size less than 1µm (on average)] zinc oxide are mixed in a Braun mixer to result in 100g of an "off"-white homogeneous powder (composition A).

The resulting stabilizer I obtained from Examples 2 to 4 is identical so far as chemical and physical properties are concerned.

Example 5

Compositions A are blends of SANDOSTAB P-EPQ (Stabilizer I) and zinc oxide as prepared according to Example 2. A hydrolysis test is carried out by inserting a sample into an desiccator and providing a constant humidity by the use of saturated NaCl in water to produce accelerating, severe conditions at 60°C and 90% relative humidity. The various samples are exposed to these conditions for the time given and analyzed. HPLC analysis of both formed 2,4-di-tert-butylphenol and residual unchanged processing stabilizer, gives consistent results for the degrees of hydrolysis. Alternatively, Compositions A are blends of SANDOSTAB P-EPQ (Stabilizer I) and zinc oxide as prepared according to Example 3 or 4.

**Hydrolytic Resistance of Stabilizer I and Composition A at 60°C/90% r.h.
(accelerated test)**

Sample	Degree of Hydrolysis* (at 60°C, 90% r.h.) after				
	0 days	4 days	8 days	14 days	20 days
control	0%	85%	n.a.	n.a.	n.a.
A (+3% ZnO)	0.1%	1.1%	1.3%	2.5%	4.6%
A (+5% ZnO)	0.2%	0.4%	1.0%	2.3%	3.9%
A (+7.5% ZnO)	0.1%	0.2%	0.9%	1.0%	1.5%
A (+10% ZnO)	0.2%	0.4%	0.9%	1.6%	4.5%

* D.O.H. = 100% - percentage of non-hydrolyzed organophosphorus compound.

The control sample without any hydrolysis guard agent hydrolyses by 50% (half-life period) within ca. 45 hours under the test conditions applied. Prolonged exposure completely destroys the sample within a few days.

The outstanding result obtained with 7.5% micronised ZnO added (as described above) to Stabilizer I is unexpected and corresponds to a significant improvement of the hydrolytic stability by more than one order in magnitude. This surprising finding is of great technical relevance since it has become possible in this way to avoid the various disadvantages described above which have been connected with the use and handling of moisture sensitive organophosphorus stabilizers in technical applications, e.g. as antioxidants/processing stabilizers for polymers.

Application Example

A polymeric composition containing

- 100.0 parts 3rd generation polypropylene homopolymer
- 0.05 parts Irganox 1010, tetrakis[methylene-3(3'5'-ditert.butyl-4'-hydroxyphenyl)propionate]methane
- 0.1 parts calcium stearate, and
- 0.07 parts of a stabiliser Composition A given in the Table below:

are mixed by dry blending and pre-extruding at 210°C. This polymeric composition is then multiply extruded in a Göttfert single screw Extruder (270°C, d=20mm, l:d=20, 50 min⁻¹ compression 1:3) and is granulated, after chilling the polymer melt in a water bath. The melt flow index (ASTM D-1238-70), 230°C, 2.16kg) and the yellowness index (ASTM D-1925-70, on granules) are determined after the first, third and fifth passage.

Table

Amount of P-EPQ %	Amount of ZnO %	Amount of HALS %	MFI			YI			passages
			1	3	5	1	3	5	
97	3	-	8.22	10.2	12.6	-0.2	0.7	1.8	
95	5	-	8.25	10.0	12.7	-0.4	0.9	1.9	
92.5	7.5	-	8.23	12.3	13.7	0.9	1.2	1.8	
97	-	3	8.43	10.0	12.8	0.6	1.4	2.6	
96	-	4	8.38	10.4	13.0	0.2	0.7	2.6	
95	-	5	8.34	10.5	13.7	0.2	1.2	2.4	

In the Table above:

HALS is poly[[6-(1,1,3,3-tetramethylbutyl)amino]-1,3,5-triazine-2,4-diyl]((2,2,6,6-tetramethyl-4-piperidiny)imino)-1,6-hexanediyl((2,2,6,6-tetramethyl-4-piperidiny)imino)) commercially available as Sanduvor 3944;

P-EPQ is tetrakis-(2,4-di-tert-butyl-phenyl)-biphenylene-diphosphonite commercially available as the product Sandostab P-EPQ and

ZnO is micronised zinc oxide.

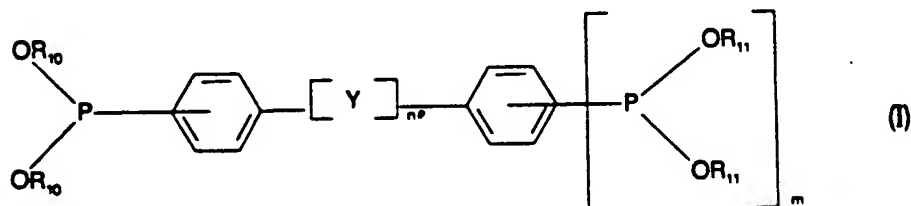
CLAIMS:

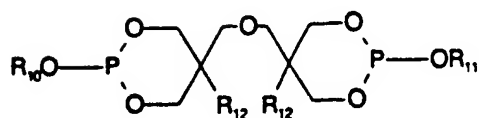
1. An additive, useful as a processing stabilizer for polymers, the additive comprising a blend (preferably a homogeneous blend) of :

- a) one or more phosphonites or phosphites (hereinafter defined as component a) with
b) a hydrolysis stabilizer selected from compounds containing a sterically hindered amine group and micronized zinc oxide.

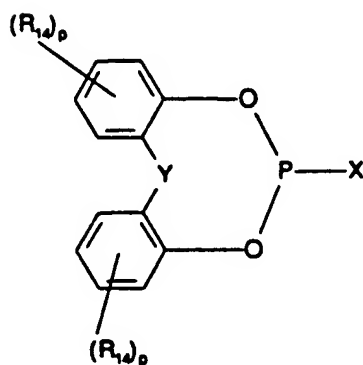
2. An additive according to Claim 1 comprising a blend (preferably a homogeneous blend) of

- a) one or more phosphonites or phosphites of formulae I to V (hereinafter defined as component a)





(IV)



(V)

in which

m is 0 or 1;

n' is 0 or 1;

p is 0 to 4;

each R_{10} and each R_{11} , independently, is a group derived from an aliphatic, or alicyclic or aromatic alcohol containing one or two OH groups; whereby the two -OH groups are not positioned to be able to form a P-containing ring; (hereinafter defined as the monovalent significances of R_{10} or R_{11} respectively);

or both groups R_{10} and/or R_{11} form a group derived from an aliphatic, alicyclic or aromatic alcohol containing two or more OH groups in such a position that they can form a cyclic group with a single phosphorus atom (hereinafter defined as the divalent significances of R_{10} or R_{11} respectively);

R_{12} is -OH, CH_2OH or $C_{1-4}alkyl$;

each R_{14} independently is selected from $C_{1-22}alkyl$ or $C_{7-22}aralkyl$;

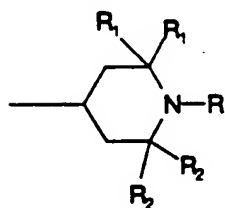
X is F or -O- R_{10} ; and

Y is -O-, -S-, -CH(R_{15})- or - C_6H_4 -; where R_{15} is hydrogen or $C_{1-8}alkyl$ or $COOR_6$ and R_6 is $C_{1-8}alkyl$; with

b) a compound containing a sterically hindered amine group (hereinafter defined as component b).

3. An additive according to Claim 1 or Claim 2 in which the amount of component b) per 100 parts of component a) is 0.05-15 parts.

4. An additive according to any one of the preceding claims in which component b) is a compound containing a sterically hindered amine group in which the sterically hindered amine group is of the formula α)



α)

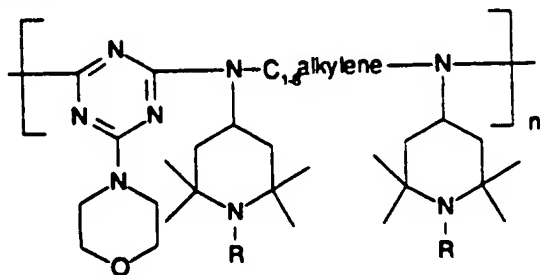
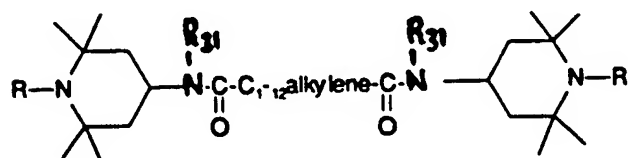
in which

R is hydrogen; oxygen; -OH; C_{1-24} alkyl; -O- C_{1-24} alkyl; -O-CO- C_{1-24} alkyl; -O-CO-phenyl or -COR₅; where R₅ is -C(R₃)=CH₂, C_{1-6} alkyl, phenyl, CO- C_{1-24} alkyl, -CO-phenyl, -NR₇R₈, -CH₂-C₆H₅, -CO-OC₁₋₁₂alkyl or -COOH; R₃ is hydrogen or C_{1-4} alkyl; R₇ is hydrogen, C_{1-12} alkyl, C_{5-6} cycloalkyl, phenyl, phenyl- C_{1-4} alkyl or C_{1-12} alkylphenyl and R₈ is C_{1-12} alkyl or hydrogen,

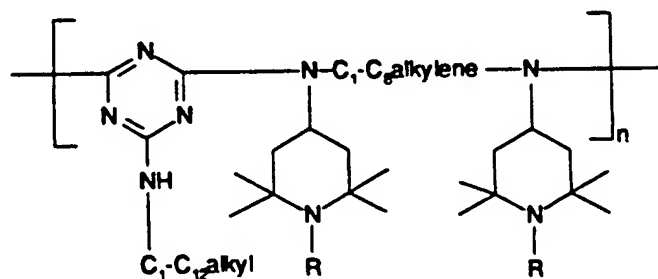
each R₁, independently, is -CH₃ or -CH₂(C_{1-4} alkyl) or both groups R₁ form a group -(CH₂)₅-; and

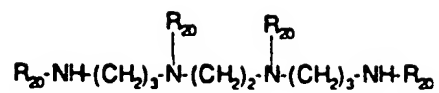
each R₂, independently, is -CH₃ or -CH₂(C_{1-4} alkyl) or both groups R₂ form a group -(CH₂)₅-.

5. An additive according to any one of the preceding claims in which component b is selected from HALS 1-HALS 17 below

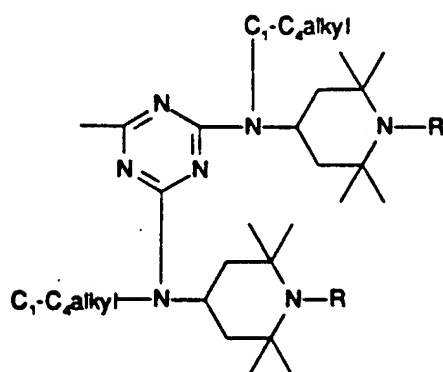
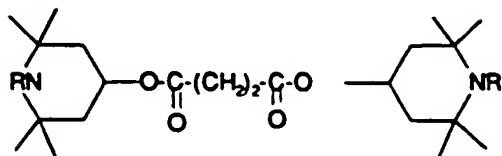
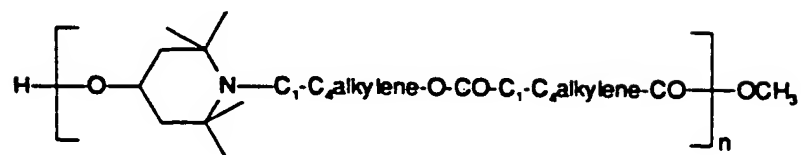
HALS 1**HALS 2**

where R_{31} is hydrogen or C_{1-8} alkyl

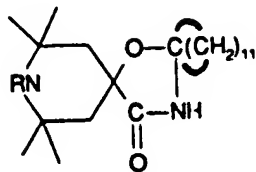
HALS 3

HALS 4

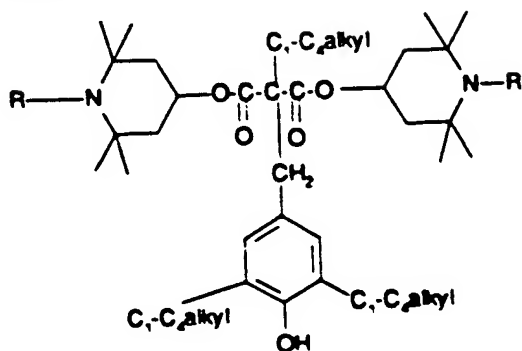
where R_{20} is

**HALS 5****HALS 6**

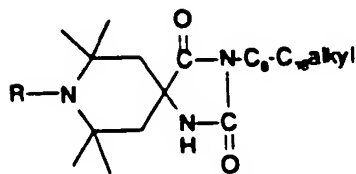
HALS 7



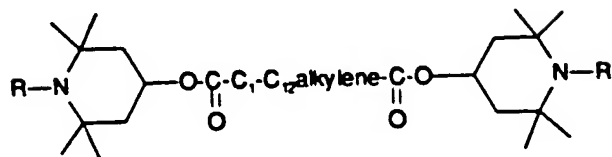
HALS 8

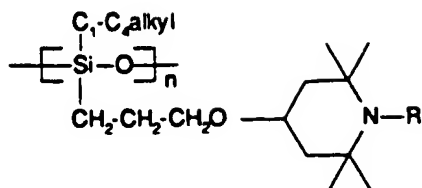
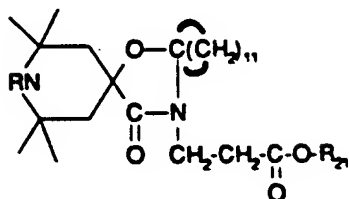


HALS 9

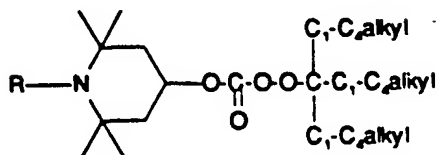
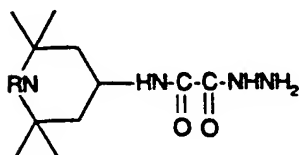


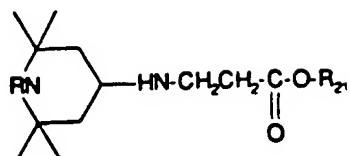
HALS 10



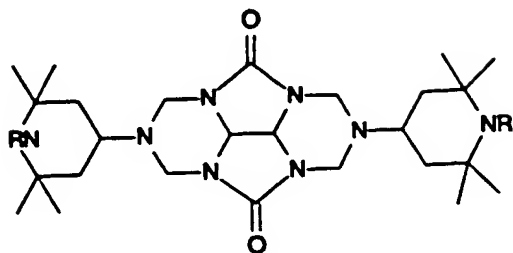
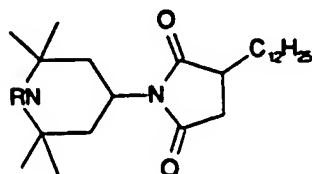
HALS 11**HALS 12**

where R_{21} is C_{12-14} alkyl (e.g. a mixture of $C_{12}H_{25}$ and $C_{14}H_{29}$);

HALS 13**HALS 14**

HALS 15

where R_{21} is as defined above

HALS 16**HALS 17**

in which in **HALS 1** to **HALS 17**

R is R' where R' is hydrogen, O , OH , C_{1-12} alkyl, C_{1-12} alkoxy or $-CO-C_{1-6}$ alkyl and

n is a number from 3 to 20.

6. An additive according to any one of the preceding claims in which component b) is selected from:

Bis (2,2,6,6-tetramethyl-4-piperidyl) sebacate;

Bis(1,2,2,6,6-pentamethyl-4-piperidiny)(3,5-ditert.butyl-4-hydroxybenzyl)butylpropane dioate;

Bis (1,2,2,6,6-pentamethyl-4-piperidiny) sebacate;

8-Acetyl-3-dodecyl-7,7,9,9-tetramethyl-1,3,8-triazaspiro(4,5)decane -2,4-dione;

Butanedioic acid, bis(2,2,6,6-tetramethyl-4-piperidiny) ester;

Tetrakis (2,2,6,6-tetramethyl-4-piperidyl)-1,2,3,4-butane tetracarboxylate;

(2,2,6,6-tetramethyl-4-piperidyl)/ $\beta,\beta,\beta',\beta'$ -tetramethyl-3,9-(2,4,8,10-tetra-oxaspiro(5'5)undecane) diethyl-1,2,3,4-butane tetra carboxylate;

7-oxa-3,20-diazadispiro(5.1.11.2) heneicosan-20-propanoic acid,

2,2,4,4-tetramethyl- 21-oxo, dodecylester;

Octadecene-(N-(2,2,6,6-tetramethylpiperidiny)-4-N-maleinimido-oxalic acid diamide
copolymer;

N-(2,2,6,6-tetramethyl-4-piperidiny)-N'-amino-oxamide;

OO-t-amyl-O-(1,2,2,6,6-pentamethyl-4-piperidiny)monoperoxi- carbonate;

β -Alanine, N-(2,2,6,6-tetramethyl-4-piperidiny), dodecylester;

Ethanediamide, N-(1-acetyl-2,2,6,6-tetramethylpiperidiny) -N'- dodecyl;

3-dodecyl-1-(2,2,6,6-tetramethyl-4-piperidiny)-pyrrolidin-2,5 -dione;

3-dodecyl-1-(1,2,2,6,6-pentamethyl-4-piperidiny)-pyrrolidin-2,5 -dione;

3-dodecyl-1-(1-acetyl,2,2,6,6-tetramethyl-4-piperidiny)-pyrrolidin-2,5-dione;

4-benzoyloxy-2,2,6,6-tetramethylpiperidine;

1-[2-(3,5-di-tert.butyl-4-hydroxyphenylpropionyloxy)ethyl]-4-(3,5-ditert.-
butyl-4-hydroxyphenyl-propionyloxy)-2,2,6,6-tetra- methyl piperidine;

2-methyl-2-(2'',2'',6'',6''-tetramethyl-4''-piperidinylamino)-N-(2',2',6',6'-tetra-
methyl-4'-piperidiny) propionylamide;

1,2-bis(3,3,5,5-tetramethyl-2-oxo-piperaziny)ethane-1-isopropyl-3,3,5,5-tetramethyl-
2-piperazinone

Tetrakis (2,2,6,6-tetramethyl-4-piperidyl) 1,2,3,4-butane tetracarboxylate;

4-oleoyloxy-2,2,6,6-tetramethylpiperidine;

Poly-[(6-morpholino-s-triazin-2,4-diyl)[(2,2,6,6-tetramethyl-4-
piperidiny)imino]hexamethylene-[(2,2,6,6-tetramethyl-4-piperidiny)imino)];

Poly-[6-[1,1,3,3-tetramethyl-butyl)imino]-s-triazin-2,4-diyl][2-(2,2,6,6-tetramethyl-4-
piperidiny)imino] hexammethylene-[4-(2,2,6,6-tetramethyl-4-piperidiny)imino)];

1,3,5-triazine-2,4,6-triamine- N',N'' -[ethanediyl-bis[[[4,6-bis[butyl(1,2,2,6,6-pentamethyl-4-piperidiny)amine]-1,3,5-triazin-2-yl]imino]propane-diyl]]bis[N',N' -dibutyl- N',N'' -bis(1,2,2,6,6-pentamethyl-4-piperidiny)]);

Butanedioic acid, polymer with 4-hydroxy-2,2,6,6-tetramethyl-1-piperidine-ethanol;

2,2,4,4-tetramethyl-7-oxa-3,20-diaza-dispiro[5.1.11.2]heneicosan-21-one;

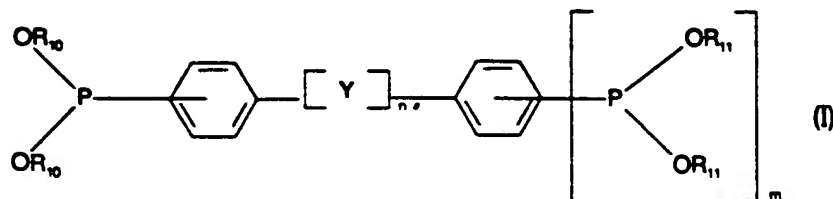
Bis(1-octyloxy-2,2,6,6-tetramethyl-4-piperidiny)sebacate;

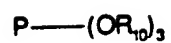
Poly(methylpropyl-3-oxy-[2,2,6,6-tetramethyl-4-piperidiny]-siloxane);

1,3,5,7,9,11-hexaaza-4,10-dione-tricyclo[12.1.10,13,14]-tetradecane-1,7-bis(2,2,6,6-tetramethyl-4-piperidiny).

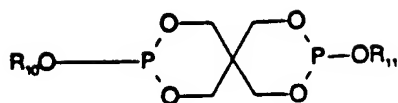
7. An additive according to Claim 1 comprising a blend of :

a) one or more phosphonites or phosphites of formulae I to V (hereinafter defined as component a)

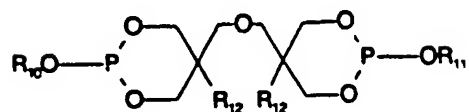




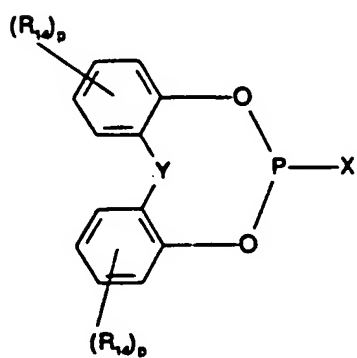
(II)



(III)



(IV)



(V)

in which

m is 0 or 1;

n' is 0 or 1;

p is 0 to 4,

each R_{10} and each R_{11} , independently, is a group derived from an aliphatic, or alicyclic or aromatic alcohol containing one or two OH groups; whereby the two -OH groups are not positioned to be able to form a P-containing ring; (hereinafter defined as the monovalent significances of R_{10} or R_{11} respectively);

or both groups R_{10} and/or R_{11} form a group derived from an aliphatic, alicyclic or aromatic alcohol containing two or more OH groups in such a position that they can form a cyclic group with a single phosphorus atom (hereinafter defined as the divalent significances of R_{10} or R_{11} respectively);

R_{12} is -OH, CH_2OH or $\text{C}_{1-4}\text{alkyl}$;

each R_{14} independently is selected from C_{1-22} alkyl or C_{7-22} aralkyl;

X is F or $-O-R_{10}$ where R_{10} is defined in Claim 2; and

Y is $-O-$, $-S-$, $-CH(R_{15})-$ or $-C_6H_4-$;

where R_{15} is hydrogen or C_{1-8} alkyl or $COOR_6$ and R_6 is C_{1-8} alkyl; with

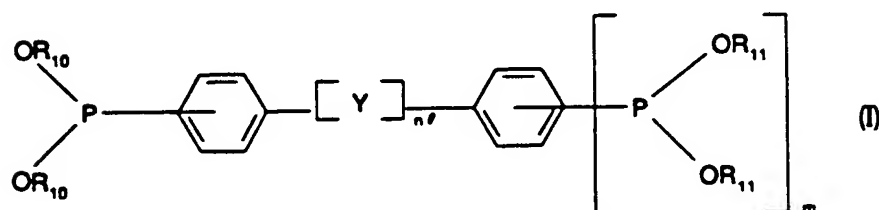
b) micronized zinc oxide

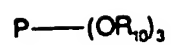
8. An additive according to Claim 7 in which the amount of zinc oxide present is 5-10% based on the weight of component a).
9. An additive according to Claim 1 substantially as herein described with reference to the Examples.
10. A polymeric composition comprising a polymeric material and an additive according to any one of the preceding claims.
11. A polymeric composition containing an additive according to Claim 1 substantially as herein described with reference to the Examples.

12. A process for stabilising a polymeric composition comprising

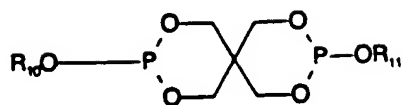
i) blending

a) one or more phosphonites or phosphites, preferably of formulae I to V
(hereinafter defined as component a)

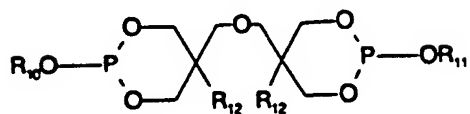




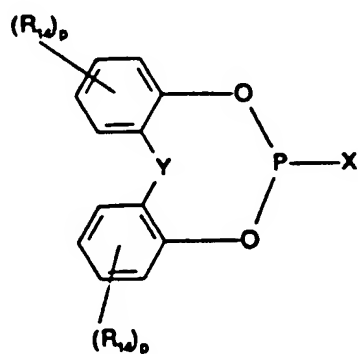
(II)



(III)



(IV)



(V)

in which

m is 0 or 1;

n' is 0 or 1;

p is 0 to 4, preferably 1 to 3

each R_{10} and each R_{11} , independently, is a group derived from an aliphatic, or alicyclic or aromatic alcohol containing one or two OH groups; whereby the two -OH groups are not positioned to be able to form a P-containing ring; (hereinafter defined as the monovalent significances of R_{10} or R_{11} respectively);

or both groups R_{10} and/or R_{11} form a group derived from an aliphatic, alicyclic or aromatic alcohol containing two or more OH groups in such a position that they can form a cyclic group with a single phosphorus atom (hereinafter defined as the divalent significances of R_{10} or R_{11} respectively);

R_{12} is -OH, CH_2OH or $\text{C}_{1-4}\text{alkyl}$.

each R_{14} independently is selected from $\text{C}_{1-22}\text{alkyl}$ or $\text{C}_{7-22}\text{aralkyl}$;

X is F or $-\text{O}-R_{10}$;

Y is -O-, -S-, $-\text{CH}(\text{R}_{15})-$ or $-\text{C}_6\text{H}_4-$, where R_{15} is hydrogen or $\text{C}_{1-8}\text{alkyl}$ or COOR_6 and R_6 is $\text{C}_{1-8}\text{alkyl}$; with

- b) a hydrolytic stabilizer selected from compounds containing a sterically hindered amine group and micronized zinc oxide (hereinafter defined as component b);

followed by

- ii) adding this blend to the polymeric material.

14. The use of zinc oxide or a compound containing a 2,2,6,6-tetramethyl piperidinyI group as a hydrolysis stabilizer for phosphorus compounds in polymeric compositions.

Relevant Technical Fields

- (i) UK CI (Ed.M) C3K (KCD, KCE, KCM, KEC)
(ii) Int CI (Ed.5) C08K 5/34, 5/3432, 5/3435, 5/49, 5/51, 5/52,
5/524, 5/527, 5/53, 5/5393

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI, CLAIMS

Search Examiner
MISS M M KELMAN

Date of completion of Search
10 AUGUST 1994

Documents considered relevant following a search in respect of Claims :- Claims 1-3, 9, 10, 11 and 12 wherein b) contain a spherically hindered amine group and Claims 4-6

Categories of documents

- X: Document indicating lack of novelty or of inventive step. P: Document published on or after the declared priority date but before the filing date of the present application.
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category. E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A: Document indicating technological background and/or state of the art. &: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X, P	GB 2263280 A	(SANDOZ) 21 July 1993 see the claims, page 6 lines 7 to 10 and page 11, lines 1 to 15	1, 2, 4, 5, 6, 9 to 12
X	GB 2260764 A	(SANDOZ) see the claims, page 10 line 15 to page 11 line 2 and the example	1, 2, 4, 5, 6, 9 to 12
X, P	EP 0553498 A2	(PHILLIPS) 4 August 1993 see the whole document	1, 2, 4, 5, 6, 9 to 12
X	EP 0426852 A1	(MITSUBISHI) see page 4, lines 21 to 24 and the claims	1, 2, 4, 5, 6, 9 to 12
X	EP 0359276 A2	(ADEKA) see the claims and page 8, lines 12 to 15	1, 2, 4, 5, 6, 9 to 12
X	US 5045577 A	(CIBA-GEIGY) see Examples 2 to 7	1, 2, 4, 5, 6, 9 to 12
X	US 4888369 A	(HIMONT) see the claims and column 4, lines 19 to 25	1, 2, 4, 5, 6, 9 to 12
X	US 4857230 A	(TONEN) see the claims	1, 2, 4, 5, 6, 9 to 12
X	US 4778838 A	(ENICHEM) see column 9 lines 52 to 66 and columns 11 to 14	1, 2, 4, 5, 6, 9 to 12
X	US 4110306 A	(ARGUS) see the claims	1, 2, 4, 5, 6, 9 to 12

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents)